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ABUNDANCE OF EASTERN NORTH PACIFIC GRAY WHALES 2025/2026

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Introduction

The Southwest Fisheries Science Center (SWFSC) regularly monitors the abundance of eastern North Pacific (ENP) gray whales *Eschrichtius robustus* through shore-based surveys. These visual surveys are conducted along the central California coast between December and February during the whales' southward migration, and they contribute to a long-term time series of abundance estimates that began in 1967 (Reilly et al. 1983, Laake et al. 2012).

The abundance of ENP gray whales showed a generally increasing trend through the 2015/2016 survey. However, subsequent estimates have indicated a decline, dropping from 26,960 whales (95% credible interval (CI) = 24,420-29,830) in 2015/2016 to 14,526 whales (95% CI = 13,194 - 16,040) in 2022/2023 (Eguchi et al. 2023a). While the 2022/2023 estimate remained higher than the 1967 baseline (13,426 whales, 95% CI = 11,171 – 16,136, Laake et al. 2012), this multi-year decline—which overlapped with an unusual mortality event (UME) that extended from 2019 to 2023—called into question the population's status.

Data from the 2023/2024 season resulted in an abundance estimate of 19,260 whales (95% CI = 17,400-21,301; Eguchi et al. 2024). This apparent annual rate of increase, however, exceeded the theoretical net productivity rate (R_{max}) of 0.062 (range 0.032–0.088) for gray whales (Punt and Wade 2010). This suggests that other factors were likely influencing the estimate. In the following season (2024/2025), the estimated abundance was 12,950 whales (95% CI = 11,690-14,450, Eguchi et al. 2025), consistent with a continued decline over time.

This report presents a new abundance estimate for ENP gray whales based on the data collected during the 2025/2026 southward migration season along the central California coast.

Methods

Data for this updated abundance estimate were collected during the 2025/2026 southward ENP gray whale migration. Counts were made from a shore-based watch station at Granite Canyon, California, by observer pairs rotating from a larger pool. Each survey day was split into six 90-minute shifts. As in the analysis described in Eguchi et al. (2025), only shifts with at least 60 minutes of survey effort were included. Some shifts were less than 60 minutes due to inclement weather and less-than-ideal sighting conditions (e.g., Beaufort sea state greater than 4). Sampling methods are described in Durban et al. (2015).

Estimated abundance was computed using the N-mixture modeling approach used previously by SWFSC for surveys conducted between the 2006/2007 and 2024/2025 seasons (Durban et al. 2015, 2017; Stewart and Weller 2021a; Eguchi et al. 2022a, 2023a, 2024, 2025). In this approach, the sighting probability of shore-based observers was estimated using data from replicate surveys (i.e., data collected simultaneously by two independent observer teams) as well as covariates affecting sighting probabilities (i.e., visibility, sea state, and observers) that were collected during the 2009/2010 and 2010/2011 seasons. These sighting probability estimates allowed the estimation of the total number of whales passing through the survey area during a watch period from the observed number of whales, including during years when replicate surveys were not conducted.

In the analysis, the start date of the southward migration for the Granite Canyon study site is set to December 1, and the end date to February 28, with the number of whales passing the watch station on those two dates assumed to be zero. The daily count data are assumed to reflect random deviates from binomial distributions representing the estimated sighting probability and the unknown true number of whales in the sampling area, which is assumed to change as a function of the number of days since December 1. The model considers two possible functions in fitting daily whale counts and selects the one that provides the best fit for each count. These functions are (i) a normal distribution with the peak in the daily number of whales passing occurring at the midpoint of the migration, and (ii) a spline fit that allows the change in the daily number of whales to flexibly match the observed daily counts without expectations about the shape of the curve. The model then internally selects the candidate function that best matches the daily number of observed whales. The final abundance estimate is the sum of the estimated number of whales passing the survey area each day, with a correction factor applied to account for those that migrate through the study area at night (Perryman et al. 1999). The modeling approach is described in detail in Durban et al. (2015; 2017).

Because the N-mixture modeling approach uses all data since the 2006/2007 season to estimate parameters that are shared[1] across yearly datasets, estimates of abundance in prior survey years change as more data are added to the analysis. Before the 2024 report (Eguchi et al. 2024), only the new estimate was provided, while estimates for previous years were retained as they had been in the reports. In the 2024 report, we provided both old and new estimates. In this report, we provide only updated estimates for all years since the 2006/2007 season. For old estimates, reference Eguchi et al. (2024).

Analysis was conducted using the same WinBUGS (Lunn et al. 2000) code used since the 2006/2007 season (Durban et al. 2017). WinBUGS was run using the R2WinBUGS package (Sturtz et al. 2005) in R (v4.5.2, R Core Team 2026).

[1] Parameters that are shared across years include mean detection probability, fixed effect coefficients for visibility and Beaufort, parameters defining the normal seasonal curve of the mean abundance in each season, and hyperparameters that define the prior distributions of parameters, including the standard deviation of observer random effects normal distribution and parameters for the nighttime passage rate.

Results and Discussion

From January 5, 2026 to February 13, 2026[2], 15 trained observers completed 302.2 hours of survey effort over 39 survey days. A total of 1,097 groups composed of an estimated 2,563 whales were counted. The highest daily count was 158 whales on 19 January 2026 (Figure 1). Due to inclement weather and other constraints (e.g., poor visibility from fog and rain), some observation periods with <60min of visual observation effort were excluded from analysis. Furthermore, groups that were moving north were excluded from the analysis. After removing these incomplete watches and northbound groups, 293.8 hours of survey effort with 2,534 whales in 1,086 groups were retained in the analysis. The estimated total abundance of ENP gray whales during the 2025/2026 southbound migration season was 17,750 (95% CI = 15,930–20,530, Coefficient of Variation (CV) = 0.0648, 20^{th}-percentile = 16,920). This estimate includes a multiplicative correction factor for nighttime passage (mean = 1.0875, standard deviation (SD) = 0.03625, Perryman et al. 1999). After the decrease observed between the 2023/2024 and 2024/2025 seasons, this higher estimate was an encouraging finding (Table 1, Figure 2).

The rates of apparent increase in some recent years (e.g., 2022/2023–2023/2024, 2024/2025–2025/2026) fall outside the estimated R_{max} (0.062) for gray whales and have occurred during periods when estimates of calf production in the population have consistently remained low (Lang et al. 2025). Similar difficult to reconcile increases in numbers have been observed in the earlier years of the time series (Figure 2). Consequently, factors other than demographic events (i.e., births and deaths) must be affecting the estimated abundance of whales passing the central California coast. These may include factors intrinsic to the survey and analysis such as sampling error, analytical bias, and/or changes in detection probabilities, as well as potential changes in gray whale migratory behavior, or possibly a combination of these factors. We plan to address some of these possibilities through targeted process studies in future survey years. In addition, a new analytical approach is being developed that includes a fully scripted, open-source workflow employing a simpler, faster, and more statistically robust algorithm for estimating gray whale abundance. This new framework does not rely on double observer teams to estimate detection probabilities but can estimate abundance precisely from a single observer team. However, periodic updates to detection probabilities are strongly encouraged.

Using the long time series of estimated abundance of ENP gray whales from Granite Canyon, CA, a recent integrated population modeling analysis indicated that fluctuations in gray whale abundance are likely associated with the availability of and access to benthic prey in the Arctic Ocean (Stewart et al. 2023). These fluctuations, which have occurred several times since the start of the monitoring reported here, match expectations for a recovered population experiencing environmental variability and associated declines in prey availability (Stewart et al. 2025). Earlier declines (i.e., the decline that occurred in the mid-1980s and the one associated with the 1999–2000 UME) were followed by periods of generally increasing numbers. However, the more recent decline associated with the 2019–2023 UME has been of greater duration and

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[2] While surveys have typically started in late December, the 2025/2026 survey start was delayed until early January.

magnitude and raises concerns that continued environmental changes in the Arctic and sub-Arctic feeding grounds could be impacting population resilience. While the apparent increases in abundance observed in 2023/2024 and 2025/2026 suggest that the population's status may have improved, the inconsistencies between years and the low calf production since 2019 highlight the need for additional research to better understand factors driving the observed patterns.

NOAA Fisheries plans to continue monitoring the population with regular surveys to estimate abundance, calf production, and body condition of gray whales. The results of these research efforts provide the best scientific information currently available on the population's status.

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Tables and figures

Table 1. Estimated abundance (Nhat) and 95% lower (LCL) and upper (UCL) confidence limits of gray whales from the visual surveys off Granite Canyon, CA. Estimates prior to the 2006/2007 season are from Laake et al. (2012), where confidence limits were computed using the lognormal distribution. For the 2006/2007 through 2024/2025 seasons, the method of Durban et al. (2016) was used.

Season	Nhat	LCL	UCL	SE	Method
1967/1968	13,426	11,171.4	16,135.6	1,262.0	Laake
1968/1969	14,548	12,439.8	17,013.4	1,163.8	Laake
1969/1970	14,553	12,371.5	17,119.2	1,207.9	Laake
1970/1971	12,771	10,899.1	14,964.5	1,034.5	Laake
1971/1972	11,079	9,236.5	13,289.0	1,030.3	Laake
1972/1973	17,365	14,848.6	20,307.8	1,389.2	Laake
1973/1974	17,375	14,799.3	20,399.0	1,424.8	Laake
1974/1975	15,290	12,972.7	18,021.2	1,284.4	Laake
1975/1976	17,564	14,844.1	20,782.3	1,510.5	Laake
1976/1977	18,377	15,714.0	21,491.3	1,470.2	Laake
1977/1978	19,538	16,448.2	23,208.3	1,719.3	Laake
1978/1979	15,384	13,154.7	17,991.1	1,230.7	Laake
1979/1980	19,763	16,800.5	23,247.8	1,640.3	Laake
1984/1985	23,499	19,744.2	27,967.8	2,091.4	Laake
1985/1986	22,921	19,523.2	26,910.2	1,879.5	Laake
1987/1988	26,916	24,026.0	30,153.6	1,561.1	Laake
1992/1993	15,762	13,797.3	18,006.4	1,071.8	Laake
1993/1994	20,103	18,050.1	22,389.4	1,105.7	Laake
1995/1996	20,944	18,585.9	23,601.3	1,277.6	Laake
1997/1998	21,135	18,500.6	24,144.5	1,437.2	Laake
2000/2001	16,369	14,526.0	18,445.8	998.5	Laake
2001/2002	16,033	14,007.2	18,351.8	1,106.3	Laake
2006/2007	19,126	16,644.2	21,977.8	1,357.9	Laake
2006/2007	20,710	18,729.8	24,260.2	2,553.1	Durban
2007/2008	18,520	16,620.0	21,971.5	1,345.7	Durban

Season	Nhat	LCL	UCL	SE	Method
2009/2010	20,270	18,580.0	22,120.2	909.2	Durban
2010/2011	21,360	19,610.0	23,330.2	929.0	Durban
2014/2015	23,860	21,540.0	27,090.0	1,383.2	Durban
2015/2016	27,270	24,889.8	29,760.2	1,263.8	Durban
2019/2020	20,100	18,349.8	21,940.0	909.5	Durban
2021/2022	17,435	15,850.0	19,180.0	848.4	Durban
2022/2023	14,590	13,300.0	16,020.0	689.1	Durban
2023/2024	19,600	17,770.0	21,510.0	953.6	Durban
2024/2025	12,890	11,690.0	14,190.2	637.1	Durban
2025/2026	17,750	15,930.0	20,530.0	1,157.5	Durban

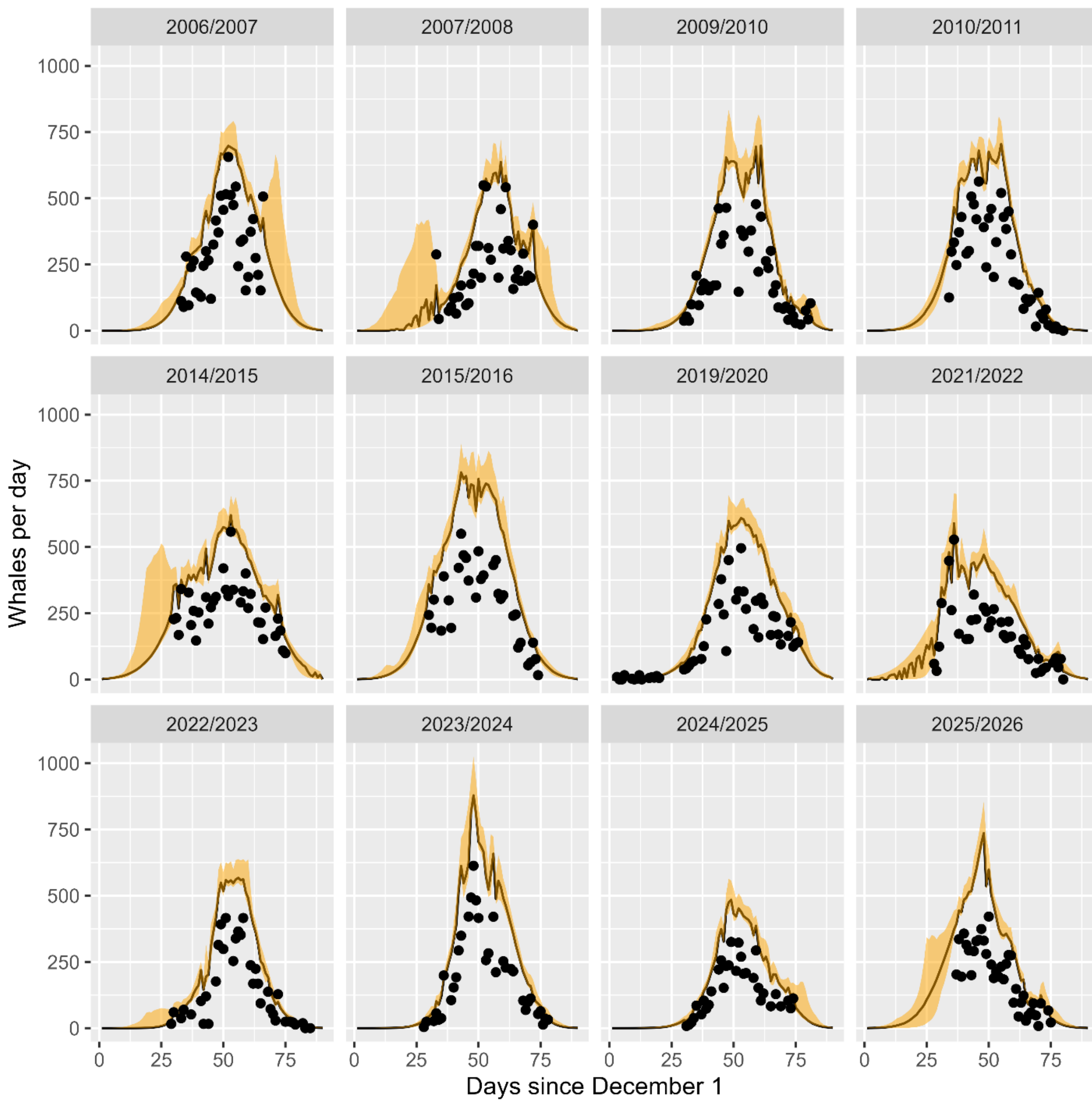

Figure 1. Daily estimated numbers of gray whales migrating through the sampling area off Granite Canyon. Black lines are medians and orange bands indicate 95% credible intervals from the method of Durban et al (2015). Solid circles indicate observed counts adjusted for the daily survey effort.

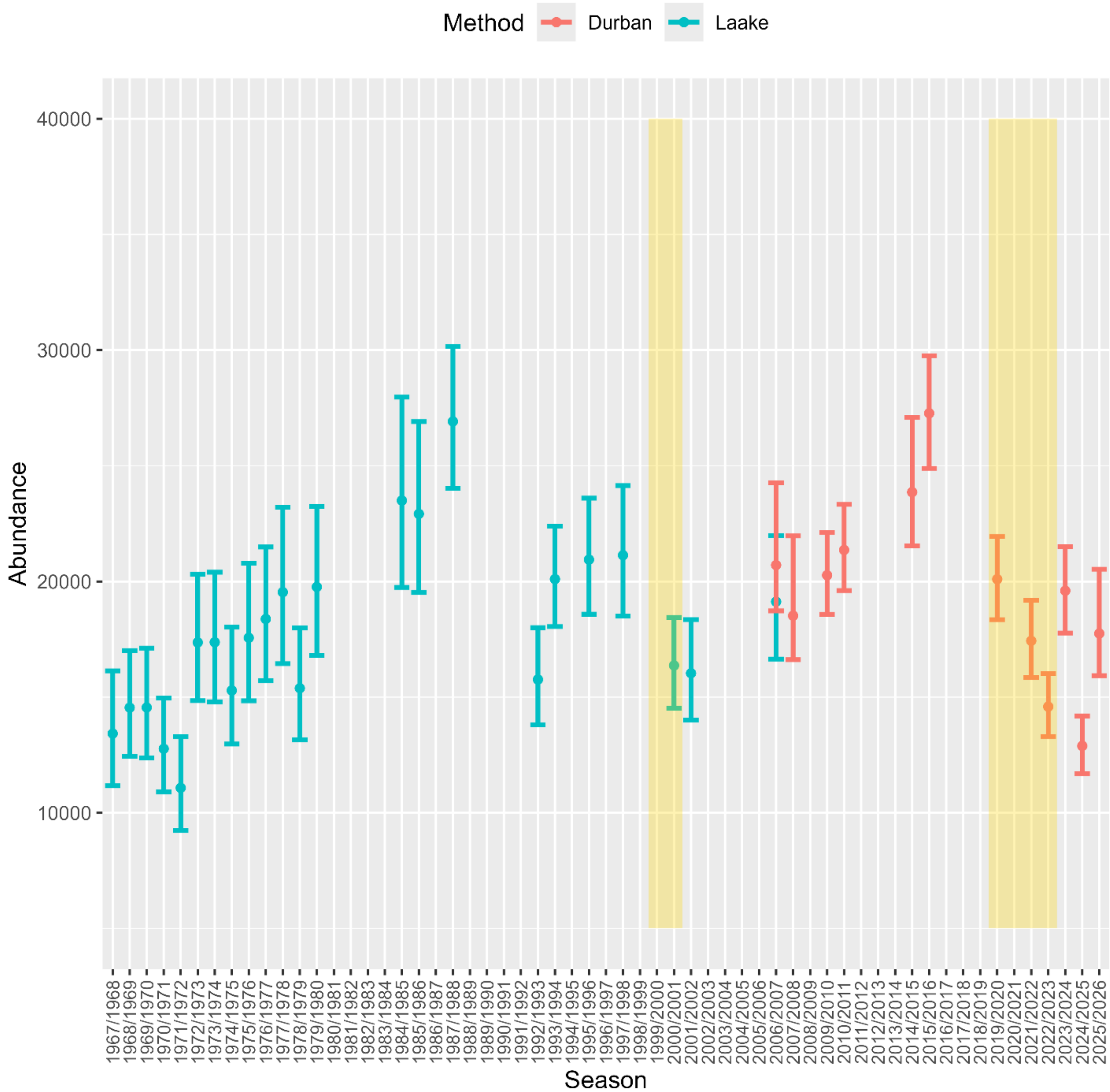

Figure 2. Estimated abundance and 95% CIs (confidence intervals for the method of Laake et al. and credible intervals for the method of Durban et al.) of gray whales from the visual surveys off Granite Canyon, CA, between the 1967/1968 and 2024/2025 seasons. Estimates in green indicate those from Laake et al. (2012), whereas those in red (from the 2006/2007 season) indicate using the method in Durban et al. (2016). Yellow bars represent unusual mortality events.